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GUANO.

A TREATISE

ON THE

HISTORY, ECONOMY AS A MANURE,

AND

MODES OF APPLYING

PERUVIAN GUANO,

IN THE CULTURE OF THE VARIOUS CROPS

OF THE FARM AND THE GARDEN.

“Guano, though no saint, works many miracles.”

Peruvian Proverb.

BOSTON:

PUBLISHED BY C. L. BARTLETT,

Agent of the Peruvian Government,

16 BROAD STREET,

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GUANO.

Guano has been severely tested by extended and repeated experiments, and the result has been to establish its reputation, not only as one of the most powerful, but as one of the most economical manures. When *properly applied*, it has seldom or never failed to produce the most satisfactory crops, and if instances of failure have occurred, they may be traced directly, either to some other than Peruvian guano, or to a want of proper knowledge of its properties, or to a lack of judgment in the application.

It is the object of this Treatise to give a few practical suggestions on the use of guano, and the results of actual trials under a great variety of circumstances and upon a great variety of crops and soils.

Before entering upon more practical points, however, it will not be out of place to say a few words of the origin and history of this article.

It is but little more than twenty years since the first cargo of guano left the coast of Peru to enter the ports of Great Britain as an article of commerce. The first consignment was made to a mercantile firm of Liverpool, Messrs. Myers & Co. in 1825, but guano, being still unknown, excited little attention till five years later when twenty casks were again landed in England, and it was soon found to be the most valuable manure in existence. So great was the confidence immediately inspired in its value as a means of increasing the products and renovating the soil of the country, that the very next year, 1841, seven vessels were employed to convey 1733 tons from the Chincha Islands to England, and the number increased in 1842 to 41 British and 3 foreign vessels, and to 13094 tons.

Before the close of 1844, no less than 20000 tons were imported into that country from the coast of Peru, to say nothing of the many thousand tons which came from the Ichaboe and

other guano islands at that time discovered. In 1855 no less than 210,000 tons were sold in England, being an increase of twenty per cent. on the consumption of 1854, which was at least twenty per cent. over that of 1853. And what was most remarkable is the fact that this enormous increase of its consumption took place in the face of a rise in the price from forty-five, to sixty-five and seventy dollars per ton.

From 1841, the commencement of the extraction of guano to any extent from the Chincha Islands, to the end of 1856, the quantity removed from these islands amounted to the enormous figure of 1,967,079 tons, of which 1,626,405 tons had been actually sold for use, 23,885 tons had been damaged, and 316,789 tons were still in the market. The aggregate amount of sales in this time was \$100,263,519 75. During the year 1857 no less than 472,965 tons were extracted, and during the first half of 1858, ending June 30th, 169,580 tons.

From the commencement of 1851, to the end of 1858, there were imported into the United States and used, no less than 673,412 tons. These statistics are gathered mainly from the most reliable source, no less than the official report of the Peruvian government itself.

According to the estimate of Liebig, one of the most celebrated of living chemists, verified by actual experiment, 1 cwt. of good Peruvian guano assumes, with proper application, the form of at least 8 cwt. of wheat. If this estimate is correct, what a vast amount of human food, and a vast increase of population the importations of guano represent!

Humboldt is commonly said to have been the first to make known to Europe in 1804, the existence of vast deposits of the excrements of fish-eating sea fowls on the islands of the Pacific, though the existence and properties of these excrements were fully described in one of the many works of Garcilasso de la Vega, published in Lisbon in 1609.

The inhabitants of Peru and Chili had used them under the name of *huano*, changed by the Spaniards to *guano*, for many centuries, and so much were they prized during the reign of the Incas, that the killing of sea fowl during the breeding season was punished by death. The deposits of these birds, therefore,

must have been continued comparatively undisturbed for many ages, since they are found in some places on the islands to the depth of from 50 or 60 to 200 feet, while, according to Humboldt, during a period of 300 years, a layer of less than half an inch in thickness had been added.

The best Peruvian guano is found on the Chincha Islands lying about ten miles off the coast of Peru. These islands are three in number, about half a mile apart, in a line from north to south, each being about five or six miles in circumference. They are formed of porphyritic or granitic rock thrown up at an early period by volcanic action, and are covered with guano in horizontal layers or strata of from three to eight or ten inches in thickness, the depth varying greatly in different parts from three or four feet to two or three hundred. These layers vary in color from white and dark gray to red or brownish buff. The white is newly deposited and continues to increase by gradual accretions from vast flocks of cormorants, cranes, flamingoes, gulls, gannets and other sea fowl. The gray is intermediate, lying below the white, and the red has been longest deposited and deepest buried. The white and gray pass by age into the red.

Guano is found on other islands on the Pacific coast of South America, between the 15th and 21st parallels of S. latitude, but none are more favorably situated than the Chinchas, since on account of the lofty range of mountains along the coast, rain very rarely falls on the islands to wash and waste away the immense deposits. Beyond the limits named, rain more frequently falls and the guano, if any were found, would have lost much of its value. On the Chincha Islands, which contain unquestionably *the best quality of guano which has ever yet been discovered*, the supply is perhaps inexhaustible, since it is said that the removal of two or three hundred thousand tons from beds which are now worked, has produced no very perceptible diminution. It is so compact and solid on account of its great depth and the slow and gradual depositions, that it is often necessary to resort to blasting. More or less hard lumps of various sizes are found intermixed with the finer qualities of guano as found in the market. They are only the unbroken

masses of the original deposit, and are identical in composition with the finer or more pulverized portions. Both the finer and the coarser particles are filled with the most beautiful infusoria, many of them splendidly colored like the rainbow, and one of the best methods of testing the genuineness of the article is by the microscope.

Guano taken from the Chincha Islands is found to be pretty uniform in its character and composition, far more so than was at first supposed from the analyses of specimens first sent to Europe, some of which were probably taken from the main land where the deposits are more or less mixed in or covered by drift sand. The more recent analyses of pure Peruvian guano present less variations.

The niceties of an analysis are of little importance or interest to the practical farmer, as they do not affect, in any appreciable way, the actual commercial or manurial value of genuine Peruvian guano. But it may be stated that its real value depends largely upon the amount of ammonia which it contains, and to nearly as great an extent, also, on the quantity of the phosphates of lime and magnesia, which exercise a very important influence on vegetation. In the analyses of thirty-two samples of Peruvian guano recently made by Prof. Way, the highest percentage of ammonia was 18.94 the lowest 15.98, the average 17.46, while the average quantity of earthy phosphates was 24.12 per cent. In Peruvian guano at the present market prices the farmer buys ammonia *at a less cost than it is possible to get it in any other form*, and this is the great secret of the vast superiority of the Peruvian over any other kind of guano, and of the great popularity and extensive and increasing consumption of that article.

Without going into the details of an elaborate analysis, therefore, we propose to give first the testimony of scientific men in regard to the value of guano as a manure ; and then to give the testimony of practical men and the results of many careful and reliable trials by experienced farmers and gardeners, and, thirdly, to state what, in our opinion, is the best mode of treatment and application to secure the largest and most profitable results. First then,

THE TESTIMONY OF SCIENCE.

Dr. Ure, in an elaborate article on the analysis of guano published in the Journal of the Royal Agricultural Society of England, says: "The general conclusion that may be fairly deduced from the whole evidence is that *good guano will, under judicious application, increase the crops of grain, turnips, potatoes and grass by about 33 per cent.; and with its present price per ton, at a cost considerably under the average cost of all other manures*, whether farm yard dung and composts, or artificial compounds." Dr. Von Martius, of Munich, a distinguished agricultural chemist, in an address to the agricultural society of Bavaria, says: "Among animal manures it clearly claims the first place. It is uncommonly rich in ammoniacal salts which act very favorably on vegetation. *It is five times better than night soil and also very superior to the French poudrette.*" The same chemist estimates that the manuring power of genuine guano is four times greater than that of pigeon's dung, which estimate is undoubtedly a near approximation to the truth. Dr. Ure, in the article already alluded to, asserts that genuine Peruvian guanos, like some that he had minutely analyzed, surpass very far all other species of manure, whether natural or artificial, in the quantity of *potential ammonia*, and, therefore, *in the permanency of their action upon the roots of plants*, while in consequence of the ample store of actual ammonia which they contain ready formed, they are qualified to give immediate vigor to vegetation.

A scientific writer in the Rural Cyclopaedia, remarks that guano is, weight for weight, 50 per cent. richer in phosphate of lime than even crushed bones; and in the same proportion must it act with permanently fertilizing power upon the soil. "This fact," remarks Prof. Johnston, "is of great practical importance. Nitrate of soda, so much used of late, and so deserving of more extensive trial, may be washed out of the soil, where the earthy part of the guano would remain; it may cease to exert a marked influence after a second crop, where it is scarcely possible that the phosphates of the guano should cease to act; and it may fail to bring to maturity crops of corn or to fill the ripened ear, when the guano would supply to the

grain, among other substances the earthy phosphates also, which the seed contains as a necessary constituent."

Prof. S. W. Johnson, of the Yale Analytical Laboratory, says: "*a good guano is the most valuable of fertilizers and properly commands a high price,*" while in a little Treatise on Manures, just published, he expresses himself as follows: "*The manner in which the importation and sale of this standard fertilizer (Peruvian guano) has been hitherto conducted, is such as to afford a sufficient guaranty of its genuineness. It maintains its uniformity and excellence of composition to a remarkable degree. The soluble phosphoric acid it should be remembered, is equal in quantity to the average amount of this ingredient in our commercial super-phosphates, and is accompanied with two to three per cent. of potash, which, though of trifling commercial value by the side of ammonia, is nevertheless of great manurial worth on the light soils where guano is most often applied.*"

The editors of the Albany Cultivator and Country Gentleman in reply to the inquiry as to the best top dressing for wheat and rye, state their opinion in the following emphatic and unequivocal language: "Of all the concentrated fertilizers we are acquainted with,—and we have used the nitrate of soda and potash, muriate, sulphate and carbonate of ammonia, bone dust, super-phosphate, Liebig's Patent wheat manure, soot, rape dust, woolen rags, and a variety of mineral manures,—*we know of none, at present in the market, so cheap and so good as a top dressing for wheat and rye as Peruvian guano. Sulphate of ammonia is a splendid manure for wheat, but at present prices, Peruvian guano, is a cheaper source of fertilizing elements.*"

Dr. Dana, author of the first and best muck manual ever published in this country, says: "The bone earth of guano gives it a permanent effect. No substance yields more substances for the wants of plants, in all stages of their growth, than guano."

Such an array of accumulative testimony, from men known to be perfectly disinterested, and distinguished for high scientific attainments, both in Europe and in this country, is sufficient on this point, though similar authorities might be multiplied indefinitely. No scientific man, indeed, has ever

expressed an opinion against the extraordinary and unequalled fertilizing properties of Peruvian guano.

THE TESTIMONY OF PRACTICE.

The Rev. J. M. Merrick, of Walpole, Ms., in a report as chairman of the committee on farms of the Norfolk Co. Agricultural Society, gives the language of a practical farmer, who says: "My experiment with guano on grass land for this, the fourth year since its application, has yielded by careful weight just twice as much as the piece adjoining, which had none." This, says Mr. Merrick, is the testimony of another intelligent farmer, who informs us that the good effects of guano are distinctly visible after five years.

C. C. Sewall, of Medfield, Mass., a successful practical farmer says: "Guano, at the rate of three hundred pounds per acre, mixed with sand, was spread and thoroughly incorporated with the soil by the harrow. Then grass seed was sown, and a light horse-harrow was afterwards passed over the ground. The result of this experiment was so successful that I have since repeated the operation several times, under like conditions, and with like good returns, and I am now convinced that it is much better for any one to follow the same, or a similar course, than to cart manure from his barn, to any considerable distance and attempt to cultivate any land suitable for grass."

David Choate, of Essex, Mass., in speaking, as chairman of the committee on farms of the Essex Co. Agricultural Society, of the great and well known success of Mr. Brown, a prominent farmer of Marblehead, says: "Wherever Mr. B. has used guano upon his grass land, as a top-dressing, he thinks every 200 pounds has given him an extra ton of hay. Early in June last, a piece of grass put on a rusty appearance and seemed dying. About the middle of June he sowed about 200 lbs. of guano to the acre upon it. The weather was rainy, and in about one week he thinks the grass was doubled, being changed in color from yellow to a lively green."

Mr. Choate in the same report, alluding to the experiments of another practical farmer of Essex Co., says they were tried

with guano and super-phosphate as a top-dressing for grass. It was upon a peat meadow, which had been in grass fifteen or twenty years without any dressing. He applied guano at the rate of 400 lbs. the acre, to a strip eight rods long, and one rod and five links wide.

The produce of hay was 253 pounds; on a strip of the same size by its side, (undressed) 56 pounds. With a super-phosphate dressing on a strip eight rods long by one wide, the yield was 138 lbs. of hay, while the same number of rods along-side, (undressed) yielded 60 lbs.

To be equal to the guano, the super-phosphate should have produced 210 lbs., instead of 138.

Mr. Charles Breck, of Milton, Mass., taking a worn out piece of land which had been mown and closely fed off for fourteen years, says: "In the spring of 1854, I staked off two square rods, which to appearance, were as nearly equal as they could be, and lying side by side. On one rod I put twelve cents worth of guano mixed with one and a half pecks of sand from the road side. On the other rod, nothing was put. In July the grass was mown, well dried and carefully weighed. On the rod which had no manure, there were six pounds of hay,—on the rod on which the guano was used, there were twenty-six pounds of hay.

"In 1855, on the first rod there were only three pounds of hay, and on the rod with guano, there were nine pounds. In 1856 I mowed and dried the grass carefully. On the first rod I had three pounds of hay, and on the second nine pounds, making in the three years, a gain of thirty-two pounds, equal to 5120 lbs. to the acre, by the use of guano that would have cost nineteen dollars and twenty cents, with a fair prospect of its continuing sometime longer, besides improving the quality of the hay very much."

Thus the testimony is conclusive that the effects of guano are lasting beyond the first and second years, most farmers who have used it carefully agreeing that these effects are distinctly visible for five or six years. The composition of genuine Peruvian guano is such, containing a large amount of phosphate of lime, larger in proportion even than bone dust, that it must of necessity produce effects which are lasting in the soil.

This is an important practical point and one in which the farmer is directly interested. The question is frequently asked whether guano, at the present prices, is profitably used on our soils, and whether the benefit to be expected from it, is not entirely exhausted by the first crop? It should be borne in mind in considering this last question, that whether its effects are durable or not, if its first results are satisfactory and pay a good interest, that is pay for the original cost of guano and working the crop, together with as fair a return as any other manure, there can be no loss on the investment. The capital is rapidly turned over, principal and interest, and ready for a new investment, thus making quick and sure returns, profitable enough even where the effects are not found to be lasting.

But to test the point in the most careful manner, a farmer in Norfolk Co., Mass., as stated in the first Annual Report of the Secretary of the State Board of Agriculture, took a piece of land which for several years had yielded only a small return for mowing, and carefully turned it up with a large plow about the last week of August, stirring the soil eight inches deep, rolling it and levelling it off. He then used Peruvian guano thoroughly mixed with sand, in order to spread it more evenly, by hand, at the rate of three hundred pounds per acre. This was brushed over with a bush-harrow. The soil varied in different parts of the field, from a light gravelly, to a deep moist loam. The seed germinated quickly and covered the surface before winter with a good body of grass, which was not much injured by frost except in a few low spots. In spring the grass grew rapidly, vigorously, and evenly. The first yield of hay was quite two tons to the acre; the year following still larger, and for four succeeding years it has been, at no time, less than a ton and a half to the acre, with no other manure during the time than two light dressings of compost.

The field was nearly a quarter of a mile distant from the farmer's barn, and he believes it would have cost more time, labor and money to have drawn and applied manure from his barn, for the first outlay, than the whole quantity of guano and and the subsequent dressings of compost. A similar trial was made the next year on an adjoining piece of land and with equal-

ly satisfactory results, and the effect of the guano is still seen after four years of cropping in the earlier greenness and growth of the grass, both before and after mowing as compared with land of a similar character, adjoining, laid down a year later, and which had received the usual tillage for two years and two heavy dressings of barn yard manure.

Equally beneficial results have followed, says the same farmer, from the use of guano on wheat and other small grains, on corn fodder, beans, pease, cabbages, squash and other vines, young fruit trees, currant and other bushes. His experience and observation lead him therefore, to venture the opinion that our farms would be, in all respects benefited, and the expense of cultivation lessened by a *judicious and liberal use of guano, wherever barn manure, though it were a gift, must be carted more than half a mile.*

Maj. S. B. Phinney, of Barnstable, Mass., Secretary of the Barnstable County Agricultural Society, says: "By the use of guano on an acre of land plowed and sown to grass, I have found beneficial results. Where the best of compost manure had been applied side by side (three tons to the acre) with guano, it was found that the crop where the guano was spread was nearly a quarter larger."

J. E. Porter, of Hadley, Mass., says: "I came to the conclusion that if I had treated my poor starved land more liberally with guano, I should have been amply repaid at harvest time. I have since practised on this plan and have had my reward."

Lucius Clapp, of Stoughton, Mass., in planting an acre of corn, says: "To test its value four rows were planted with guano. These were harvested separately and compared with four rows adjoining. The result was at the rate of ten bushels to the acre in favor of guano, the corn being also sounder."

He also says: "I have also tried an experiment on grass land, 150 lbs. being sown on half an acre of low moist land. The guano was sown at the commencement of a heavy rain, about the 20th of April. The result was highly satisfactory; the crop being double of last year, while all around was lighter."

The editor of the American Farmer, Baltimore, Md., in the number for July, 1859, says: "We had the opportunity re-

cently of remarking the effect of Peruvian guano as a top dressing during three successive years. It was applied two years ago to a hill side when in wheat, and the effect in that crop was very apparent. This spring, two years after, it is equally apparent in the heavy growth of orchard grass. On another piece of land the Timothy has entirely run out except upon a strip which, owing to its being thinner than the rest, was top-dressed with Peruvian guano. On this the Timothy is still vigorous and well set."

Mr. Alfred Montague, of Sunderland, Mass., wishing to test the comparative value of guano and the first quality of hog manure on a cold soil to be planted with corn, plowed and furrowed the piece, and on half of it put hog manure in the furrow at the rate of twelve loads to the acre. On the other half he put 150 lbs. of guano to the acre. The cost of the manure applied to the land was fifteen dollars, and of the guano, five dollars, making a difference of ten dollars per acre. "As near as I can judge," says he, "at the present time, there are ten bushels more of corn on the half that was guanoed, than on the other half."

A thousand other similar statements of practical farmers in various parts of the country might be given did space permit. Men began by using a bag, or a few hundred pounds, carefully experimenting perhaps, and if they used ordinary good judgment in applying it, with decided success, till they were satisfied that it was cheaper and more economical than any other kind of manure, easily transported to distant parts of the farm, saving an enormous amount of labor of teams and men.

At first one appears to be unable to comprehend how only two or three hundred pounds of guano can maintain land in as good order and produce as luxuriant crops as the six or eight cords of barn-yard manure, which he has been accustomed to use. We are apt to forget that everything that enters the plant and goes to nourish and sustain its growth, must first be dissolved, and that the actual essential fertilizing elements of six cords of stable manure, might be compressed into an exceedingly small compass. Compressed into one single cord, instead of six, the cost of handling and carting would be proportionably

less. Now the straw, the hay, the stalks, the leaves, the weeds, the loam, &c. &c., which compose the great bulk of our stable or barn-yard manure, are comparatively inert as fertilizers. A long time is required for them to develop, by fermentation and decay, the slight fertilizing properties which they possess. They serve a good purpose, it is true, in the mixture with the solid and liquid excrements of animals, since they absorb and retain the ammonia which is developed from the decay and fermentation of these excrements, but they largely increase the expense of the use and application of these manures.

It is well known, that on an average, all but four hundred pounds out of a ton of ordinary barn-yard manures which are loaded and handled and composted and spread, or otherwise handled over, often, too, in the midst of other pressing spring work, is nothing but common *water*, such as we are deluged with every spring, and the actual fertilizing elements found in a ton of such manures, would of course be found to weigh a good deal less than 400 lbs. This must be a consoling reflection to those who buy the coarse strawy stable manures of the cities or elsewhere, and team them, often, for several miles at great cost of time and labor, to say nothing of wear and tear of vehicles and cattle.

Again it should be borne in mind that a very large amount of the substances which are found in farm yard manure are precisely identical with those which are found in the greatest abundance in the soil, or which are in themselves very cheap and easily procurable, such as lime, magnesia, silica or sand, oxide of iron, alumina, &c. It could not be expected, therefore, that when these substances, which form the great bulk of the actual constituents of good farm yard manure, are added to the soil, they would produce any very striking effect upon it. There are other constituents, however, found in farm yard manure which do produce very striking effects; one of these is nitrogen, but unfortunately this most valuable substance is found only in very small quantities even in the best of such manures. When these manures are applied to the cereal crops, it is chiefly the nitrogen which produces the effect, notwithstanding it exists in small quantities. Phosphate of lime is also found in farm yard

manures and this is the special substance which root crops require in great abundance ; but this unfortunately, though one of the most important fertilizing materials is found only in small quantities in yard manures. These two constituents, together with the less valuable alkalies, potash and soda, also found in farm yard manures, are largely required by all plants. Now the chief value of guano depends on the fact that it concentrates these very substances, and that these substances are found only in small quantities in the soil ; all farm products require them in larger quantities, all soils contain them in smaller quantities, than any other substances which are ever found in farm yard manures.

Can it be inferred from this that farm yard manures are valueless in the soil ? By no means. These manures are perfect and universal manures so far as they go. They serve a most important purpose and are indispensable. Concentrated manures serve a different and special purpose. Farm yard manures produce a mechanical as well as a chemical effect on the soil. They lighten it and admit the air. These mechanical effects are produced by no concentrated manure, and consequently no such manure can be a complete substitute for the coarser farm yard manures. It is as a direct food for plants, which farm manures contain in small quantities and which good guano contains in so large quantities, which makes it so valuable, and it is unreasonable to expect it to produce the same mechanical effect on the soil which coarser manures produce. Hence it is as an addition or an auxiliary to other manures that it has an immense value on all soils and for all crops, while on soils whose physical texture does not require the modification of coarse manures, it is the most perfect and complete substitute for them, that has ever yet been found, or ever yet been manufactured.

And so experience accords with this view of the comparative value and effect of coarse and concentrated manures, for the most careful experiments made in the Duchy of Cleves in Prussia have proved,—and the general estimate there accords with it—that 100 lbs. of guano is equal to five tons of dung ; and a similar estimate is put upon it by the farmers of Scotland. And it is further estimated that *the increased nutritive value of the*

crops grown with guano as compared with those grown on poor soils is at least 20 per cent.

This important point, too often overlooked by our farmers, is alluded to as agreeing precisely with the experience of several to whom we have referred in the preceding pages.

Soils whose physical texture requires to be modified by the application of coarse stable manures, will generally be more permanently improved by thorough draining at the outset; but if these manures are to be used, their value and effect may be very largely increased by the addition to them of good guano, as we shall see when we come to speak of the importance of a mixture of manures and the proper and most economical modes of applying guano.

GUANO ON SPECIAL CROPS.

Grass Lands. The grass and hay crop of the country being paramount to all others, let us see the economy of manures upon that. Guano is generally applied to grass as a top dressing, and when it is done judiciously in point of time and quantity, it has very rarely failed of producing results in the highest degree satisfactory, giving quick and large returns for the outlay.

To test this point the Hon. Henry W. Cushman of Bernardston, Mass., staked off fifty square rods from the centre of a piece of mowing of some three or four acres on a piece of old land not very productive, and which had not been manured for three or four years. "On the 16th of May," he says, "a damp day, I sowed on this piece at the rate of 215 lbs. of Peruvian guano to the acre—1 1-3 lbs. to the square rod. The result was a very visible and immediate effect on the growth of the grass—so much so that the boundaries of the piece on which guano was sown could be seen at the distance of forty rods or more. The quantity of grass produced, so near as I could judge without weighing, was about *double* that on the adjoining land, or at least a gain of seventy-five per cent.

"The advantage of using guano as above may thus be stated," says Gov. Cushman: "Quantity of hay on land on

which guano was not used, say one ton per acre. Increase by the use of guano, three fourths ton per acre. Value of three fourths ton of hay, less expense of cutting, say \$8.00; cost of guano, 215 lbs. at \$65 per ton, \$7, making an actual profit of one eighth, besides the increased quality of hay on the same land. "I also measured off thirty square rods from another part of the same lot and applied at the rate of 160 lbs. of guano to the acre—or one pound to the square rod. The result was similar to the foregoing, with this difference, that the quantity of grass was proportionally less. It is my opinion that 250 lbs. of guano to the acre is the *minimum* quantity that should be applied to produce the most profit."

Mr. William Gregg, of Freeport, Me., says: "Guano has been applied to grass lands in this town, both last year and this, on almost every variety of soil with uniform success, in every case increasing the crops. In one instance, one hundred and fifty pounds of guano, spread on three fourths of an acre,—soil a clayey loam, *quadrupled the crop of grass.*"

A Norfolk county farmer as reported in the Second Annual Report of the Secretary of the Mass. State Board of Agriculture, says: "*When judiciously applied, guano has resulted well, especially on mowing lands doubling the growth.*" An experienced farmer in Middlesex county in the same State got double the crop of grass from land where guano was applied the autumn previous.

Mr. P. L. Osborn, of Danvers, Mass., applied 25 lbs of Peruvian guano at the rate of 240 lbs per acre late in April to ten square rods of high, flat, moist meadow of fair soil, which had been mown for a dozen years without any manure, or any cultivation whatever. When the crop was fairly grown he cut from the ten rods 253 lbs of good hay. From an adjoining lot of the same size and soil, where no guano was applied, he cut only 56 lbs, showing an increase of more than four hundred per cent. produced by the application of guano.

Similar instances of careful and accurate experiment are innumerable, and we repeat here what we have already said, that *wherever the application of a sufficient quantity of Peruvian guano to grass land has failed, it has been owing to a want of proper care and judgment in using it.* Such is its character and composition that it *cannot fail if it is judiciously applied.* Its results

are uniform and well known, and where it has been most used it is most highly prized.

GUANO ON INDIAN CORN.

It is speaking within bounds to say that the judicious use of guano on the corn crop by every farmer in New England in the year 1859, *would have added millions of bushels to the aggregate yield of that section alone, from the simple fact that it hastens the growth and maturity of the plant, and puts it out of the way of the frost.* And whenever such a season as the last occurs, the same will always be true. Numerous instances might be mentioned to substantiate this statement, if it needed any corroboration.

Mr. Alfred Montague, of Sunderland, took a piece of sandy plain, too poor to produce anything but a light crop of rye once in three or four years, plowed in 300 lbs of Peruvian guano per acre, gave it a light harrowing, planted and hoed twice, at a cost of eleven dollars, and took from it 25 bushels of good sound corn, being a net profit of \$14, or 130 *per cent. on the cost.* “*The profit on this acre,*” says he, “*would purchase two acres of such land at the present market value.*” His statement of an experiment to test the comparative value of guano and hog manure on cold land, in corn, has already been given. “These and other trials,” he says, “have fully satisfied me, that while we can procure guano for three cents a pound, we may be confident that if properly used *a fair annual investment in it will return a good income, whether applied to warm or cold lands.*”

Col. David Moseley, of Westfield, taking a gravelly pasture that was never manured before, plowed in the fall and cross-plowed in the spring and sowed one ton of Peruvian guano upon eight acres. The corn was planted in hills three and a half feet each way, the guano having previously been mixed with a fourth part its own bulk of soil. The piece was cultivated twice, requiring but little hoeing. It yielded 218 bushels of good shelled corn, and “all that saw it,” says he, “judged that the guano increased the crop 100 bushels; the stalks, sold for \$30, would not have brought more than ten; the corn sold for \$110; so that the guano gave a profit of \$77. I am confident it pro-

duced more corn than \$100 worth of manure, to say nothing about drawing it one and a half miles. In the fall I sowed the above to rye, adding 150 lbs guano per acre ; *it more than doubled any previous crop and gave fifty per cent. more grass, for feed, than ever before.*"

Col. Moseley had so great confidence in it as an economical and reliable manure that he followed up its use the next spring, plowed in fifteen cart loads of good stable manure per acre on nine acres of warm river land, and then sowed 250 lbs Peruvian guano per acre, and went over it with a bush harrow. It was planted on the first of May with the Dutton corn. "Every hill," says he, "came up and was healthy, and of a dark green color, and was even over the whole field. The first week in August the ears were suitable for boiling ; I cut it up the second week of Sept. and husked in Oct. perfectly ripe and dry ; good judges admit that *the guano increased the crop at least 20 bushels per acre, and was ten or twelve days earlier for the guano ;* so that 1350 lbs guano gave an increase of 180 bushels of corn. Upon one acre of the same field I sowed 300 lbs. guano *without any manure*, harrowed and bushed it in, planted at the same time and cultivated with the other. On harvesting, it was better every way than where it was manured and 150 lbs guano applied, showing plainly that *300 lbs. of Peruvian guano will make more corn than 15 good loads of good stable manure.*"

Mr. Rufus Sanborn, of Hampton Falls, N. H. plowed his land with a Michigan plow, sowed on 200 lbs. of Peruvian guano to the acre, plowed it again lightly, and put 100 lbs. in the hill and 200 lbs. more round the hills before the second hoeing, and gathered *ninety-eight bushels of shelled corn to the acre*, as measured by his neighbors, and received the first premium of the Rockingham Co. Agricultural Society for his crop. He had no doubt the guano added very largely to it. With an improved corn planter the guano in a mixture of $3\frac{1}{2}$ parts to one part of charcoal or wood ashes, can be dropped in the hill and covered an inch deep with soil, the same machine at the same time dropping the corn. With hills 3 1-2 feet apart each way it would apply at the rate of a spoonful of guano to a teaspoonful of charcoal or ashes, and as the guano is covered with soil, the seed does not come in contact with it.

Nearly, if not quite, every instance, where Peruvian guano has failed to produce profitable results on corn, may be ascribed to want of proper care in applying it. Hon. H. F. French, of Exeter, N. H. says: "I applied guano to about one acre of corn, at the rate of about one ounce to the hill, and covered it about one inch and a half deep, *with a hoe*, with my own hand, *not one single hill was injured*, and the whole was much benefited, while close by, on similar soil, part of a neighbor's corn-field to which guano had been applied, looked as one might imagine Sodom and Gomorrah to appear after the first shower of fire and brimstone; one half of the piece was nearly destroyed, while the other grew very handsomely. I inquired the reason of the difference, and was informed that the first half was carefully covered with a hoe and the other with the foot." The fact is, that if no injury occurred from a too immediate contact of the seed with the guano, it would indicate that the article was defective, or some other than pure Peruvian guano. The fault of the failure lies with the farmer himself, and not with the guano, if he neglects to use the proper precautions.

GUANO ON POTATOES.

There is a common impression among farmers that putrescent or farm yard manures have a tendency to increase the rot in potatoes. This has been fully confirmed by recent and very careful experiments, and may be considered as fully settled. In a case reported but a short time since, 30 tons of farm yard manure, costing \$37.50 produced 160 bushels of sound, and 160 bushels of unsound potatoes, on an acre and a quarter. The market value of the crop was \$115.00, or a value, after deducting cost of manure, of \$77.50, while 800 lbs. of Peruvian guano costing \$30, applied to the same extent of contiguous land, produced 186 1-2 bushels sound, and 120 bushels of unsound potatoes of a market value of \$123.75, or a value, after deducting cost of guano, of \$93.75. Potatoes contain a large percentage of potash, yet notwithstanding this fact, potatoes require ammonia and phosphates to a greater extent than most other vegetables, and as Peruvian guano contains from 16 to 18 per cent. of ammonia, and some 25 per cent. of phosphates, it is admirably

suitable to this crop, and is unquestionably one of the very best artificial or concentrated manures to bring the plant to the highest development. The editor of the Genesee Farmer, at Rochester, N. Y. instituted a series of the most careful and accurate experiments to ascertain the manures best adapted to the potato, and in a recent number of that valuable journal these experiments are alluded to as follows:

"In the same field on which the above experiments were made two acres were planted with potatoes without manure, and two acres with 300 lbs. of Peruvian guano per acre sown broadcast. The two acres without manure produced 238 bushels, and the two acres dressed with guano produced 410 bushels, or an increase of eighty-six bushels per acre." In these trials 400 lbs. of unleached wood ashes gave an increase of only five bushels per acre, while 150 lbs. of sulphate of ammonia gave an increase of 45 bushels per acre, and 150 lbs. of sulphate of ammonia and 300 lbs. of superphosphate of lime mixed, gave 84 bushels per acre. Since the above experiments were made a series of forty-seven experiments have been made in Scotland fully confirming the results of the editor, and in which Peruvian guano gave the largest increase of potatoes of any single manure, and was shown also to give the best results as an auxiliary to farm yard dung. These results are so striking that they are worth preserving in a tabular form:

Manures, use and quantity per acre,	No. bushels per acre.	Increase in bushels per acre
No manure.	157	
896 lbs. of sulphate of lime,	168½	11½
663 lbs. of superphosphate,	191	34
376 lbs. Peruvian guano,	275	118
252 lbs. sulphate of ammonia,	179	22
224 lbs. of nitrate of soda,	193½	36½
15 loads of farm manure,	189½	32½
15 loads of farm manure and		
896 lbs. of sulphate of lime, }	180	23
15 loads of farm manure and }		
376 lbs. of Peruvian guano, }	300½	143½
15 loads of farm manure and }		
663 lbs. of superphosphate, }	214½	57½
15 loads of farm manure and }		
252 lbs. of sulphate of ammonia }	201	134

These results correspond with those of Mr. Rufus Sanborn, of Hampton Falls, N. H., who planted potatoes on dry land on which he had previously applied sixteen loads of manure, plowed in. He put 100 lbs. Peruvian guano into the hills, on half an acre, leaving the rest with no manure except what was plowed in. He dug the potatoes in July and sold them at an average price of \$1.50 a bushel, getting just twenty-five per cent. more potatoes where guano was applied, and they were of better size. The crop was 100 bushels per acre. The value of guano and labor of applying it was three dollars, and the gain by its use about twelve and a half bushels of potatoes which sold for \$18.75. On another piece he applied swamp mud in the hill to the whole, and to a part Peruvian guano at the rate of 100 lbs. per acre. The guano increased the crop one bushel in ten. The crop on that piece was 200 bushels to the acre, so that the 100 lbs. of guano, costing \$3, gave twenty bushels of potatoes worth about \$16, being later and of less price than the preceding crop.

The experiments most carefully conducted at the Massachusetts State Farm, in Westboro', and reported in the Second Annual Report of the Secretary of the State Board of Agriculture, show conclusively that guano produced the largest and most profitable results as compared with any other manures used. On two acres planted with potatoes and 400 lbs. of guano applied in the hill, the product was 179 1-2 bushels per acre. On two other acres which had been mown three years without any manure, till the land was broken up the year previous to the experiment, and sown with corn for fodder, on which no manure was used, 400 lbs. of guano to the acre produced 379 bushels or 189 1-2 bushels to the acre. The committee, Hon. M. P. Wilder, Chairman, remarked with regard to these experiments, that "*Guano yielded the largest crop, even on land which had received no manure for four years.* In this instance, ten dollars' worth of guano produced 189 1-2 bushels of superior potatoes per acre.

"In relation to guano they confirm the general sentiment which has obtained, both in this country and in England, from its use, and assign it a place among the most economical and valuable

fertilizers. It possesses peculiar advantages in humid climates and in clayey, argillaceous soils, where evaporation is less active than in thin or silicious grounds. Hence in England its use has been continually increasing; and here, as there, it has proved not only useful for all crops, but peculiarly successful in the potato and wheat crops." And this distinguished horticulturist says: "The doubts which have been expressed in relation to its durability and utility may be ascribed to its limited use and the want of scientific application."

Col. Moseley, of Westfield, whose experiments have already been alluded to, says: "Peruvian guano does equally well on the potato crop: 300 lbs. have given me more bushels of potatoes than 20 loads of stable manure."

Wm. C. Little, of Hampstead, N. H., selected six rows in a piece of potatoes; two for guano, using a table spoonful in the hill; two for super-phosphate, using the same quantity in the hill, and on the other two, put a shovelful of green manure in the hill. The guano rows yielded 4 bushels, the super-phosphate, 3 1-3, and the green barn yard manure, 3 1-3. Mr. Little thinks there is a very great incidental advantage in the use of guano, inasmuch as crops planted with it are less infested with weeds, the seeds of which are introduced in stable manure. The trouble and cost of hoeing are consequently less.

GUANO ON WHEAT.

Wheat lands cannot fail to be benefited by a judicious application of guano and other nitrogenous manures. Manures rich in ammonia not only increase the crop, but also produce a grain richer in gluten, and therefore intrinsically much more valuable. Hermbstadt, a celebrated German chemist, took ten patches, each of one hundred square feet—of the same soil, (a sandy loam) and manured them with equal weights of different manures in the dry state, and sowed equal quantities (1-2 lb.) of the same wheat, and collected, weighed and analyzed the produce. He found that the wheat on the plot unmanured contained only 9.2 per cent. of gluten, that manured with vegetable manure 9.6 per cent., that manured with cow dung 12. per cent., that man-

ured with pigeon's dung 12.2 per cent., that with horse dung 13.7 per cent., that with human urine 35.1 per cent., that with goats' dung, 32.9, that with sheep's dung 32.9, that with night-soil 33.9, and that with ox blood 34.2. Guano was not used in the experiment, but the fact that it is exceedingly rich in nitrogen, or in ammonia, the form in which the plant procures its nitrogen, shows that, in this respect, it must prove the most valuable application within the farmer's reach, since it is admitted on all hands to be the cheapest source from which ammonia, and of course nitrogen, can be obtained. Good Peruvian guano is very nearly identical with blood, urine and night soil, in the amount of nitrogen it contains in the form of ammonia.

As seen in the careful experiments given above, the gluten abounds in wheat in proportion as nitrogen is found in the soil or is supplied to it. The hardest varieties of wheat, which contain the most gluten, contain, also, the most nitrogen which promotes the rising of the dough, so necessary in making good and light bread, and the quantity of this substance (gluten,) varies, according to the soil or the manure, from 5 per cent. in poor qualities to more than 30 per cent. in the best. Hence, supposing the quantity of wheat per acre were not increased by the liberal use of guano, the intrinsic value of it is largely increased, since the quality is greatly improved.

Guano is certain in its effects on wheat. The Hon. James A. Pearce, U. S. Senator from Maryland, an extensive farmer, applied 350 lbs. of guano to an acre of growing wheat, the land being entirely unimproved, and very poor. It was applied as a top-dressing. "*The wheat was doubled in quantity* at least; — fine clover succeeded it, and in two crops, one of corn and one of small grain, three and four years afterwards, the effects are still apparent." This result is in accordance with the opinions of the editors of the Albany Cultivator, already stated.

At a meeting of the Reading (England,) Farmers' Club, after a full and complete discussion of the best and cheapest manures for wheat, it was resolved as an expression of the opinion of the farmers present, "That it is the opinion of this meeting that nitrogen is the specific manure required by

wheat, and that *Peruvian guano is the best and the cheapest medium through which it can be obtained.*"

GUANO ON RYE.

What has been said of the effect and value of guano on wheat, will apply also to rye, and indeed to the cereal crops generally, and the mode of application would not, of course, materially differ. Both careful experiments and the general practice of those who have used guano most extensively, corroborate the statement that this is the best and cheapest manure for wheat and rye especially.

Moses Stebbins, of South Deerfield, Mass., says: "The field on which I used guano, contains 8 acres, consisting of loam, sand loam, with a coarse sand subsoil, clay loam and a red gravel; each variety of soil has been treated alike with guano for five years in succession. I consider it as valuable on loamy soils as on sand, and *I think that my land has improved 100 per cent. with Peruvian guano.*" His account with guano on wheat and rye is given in full in the *Agriculture of Massachusetts* for 1859, where his crop for 1859 is stated as being:

Debtor To 800 lbs. Guano,	\$	24	00
" 800 " Plaster,		4	00
" 4 bushels Seed Wheat, \$2 00		8	00
" 3 do Rye, \$3; int. 12 00		15	00
" Plowing, sowing, harvesting, &c. 30 00			
			<hr/>
			\$ 81 00
Credit By 77 7-10 bushels Wheat, \$2,	\$	155	40
" 79 1-2 do Rye, 1,		79	50
3 1-2 tons Straw, 6,		21	00
			<hr/>
			\$255 90
			<hr/>
			\$ 174 90
The sum total of expenditures for 5 years is	\$	576	55
Income of products of five years, - - - - -		1231	23
			<hr/>
Balance in favor of Guano in the 5 years, - -	\$	754	68
To which may be added improvement on land, - -		160	00
			<hr/>
			\$ 914 68

Mr. Stebbins received the *first premiums* of the Hampshire Franklin and Hampden Agricultural Society, for crops of *wheat and Rye grown with guano in 1859.*

GUANO ON OATS.

Experience shows that a somewhat smaller quantity of guano per acre, should be used for oats than for either wheat or rye, otherwise the growth of straw is too much encouraged and the oats are more liable to lodge.

In a careful trial made by Mr. Theodore G. Huntington, of Hadley, Mass., the oats not only yielded much more, but were of much better quality, where the guano was used, and this result has been obtained wherever guano has been properly applied to this crop. Mr. Huntington applied it at the rate of 200 lbs. per acre, on a cold, dry loam. A piece was left undressed to note the difference. Taking the crop from a rod of the guanoed part and another rod contiguous to it, of the unguanoed, he found that that dressed with guano, yielded 12 quarts of oats, weighing 10 lbs., and straw 10 1-4 lbs. This, per acre, would be 50 1-2 bushels, worth, say \$26 75, and 1040 lbs. of straw, worth \$6 56, making \$33 31 per acre. The rod which received no guano, yielded 8 quarts of oats, weighing 5 6-16 lbs, or at the rate of 29 bushels, weighing 30 lbs. per bushel, and worth, say, \$14 50, and 820 lbs. of straw, worth, say \$3 28, or in all, \$17 78, making a difference per acre in favor of guano of \$15 53.

All substances containing nitrogen may be regarded as special manures for the cereal and the grass crops. This substance promotes a luxuriant growth of these crops, and hence its striking effect when properly applied to wheat, rye, and oats.

GUANO FOR BUCKWHEAT.

Mr. Samuel F. West, of Columbia, Conn., says: "In the summer of 1854, about July 1, we sowed four acres of buckwheat. The land was then very dry and continued dry for many days, insomuch that a small part only of the grain came

up, and we were apprehensive that we should lose our crop. We harrowed in at the time of sowing the seed, 100 lbs. of guano per acre. After many days rain came and we have never had better results from guano; it was apparent to every one who noticed the field, for we left a small part unguanoed. On that part *the yield was not as large by two thirds. We never had guano fail*, even by sowing in dry weather."

Mr. W. H. Yale, of Meriden, Conn., had a piece of land that was nearly worthless, bought for ten dollars an acre, and which never before paid the interest of that, to say nothing of fences and taxes. He states the case as follows: "I plowed, as I thought, about 3 acres, the latter part of June 1856, (since measured and found to contain 3 acres, 1 rod, 12 rods.) Sowed the 9th of July, with buckwheat and 350 lbs. guano, on two and a half acres, harrowed in with the grain. Where no guano was put, the grain was about a foot high; some of it so short that it would fall through the cradle. I do not think there was more than 8 bushels on that part. The rest of the grain would average about three feet high. The whole when cleaned up yielded about 77 3-4 bushels. The 2 1-2 acres must have yielded nearly 70 bushels,—the grain being badly tangled, a good deal shelled out when I was cutting it.

Four days work self and team,	\$ 8 00
2 1-2 bushels grain for seed,	1 87
Guano, 350 lbs., - - - -	10 50
Boy and team to harrow it in, - -	1 50
Sowing Guano, - - - - -	1 00
Cutting, 3 days, - - - -	3 00
Raking and thrashing 3 days, - -	4 00
	<hr/>
	29 87

77 3-4 bushels buckwheat at 62 cts., the price at the mill, \$48 20. The straw was worth \$5 or \$6 for bedding cattle and will more than pay for cleaning the grain, carting to mill and interest on the land."

The Hon. H. W. Cushman, of Bernardston, whose experiments with guano on other crops have been alluded to, says: "By my experiments last year, I find guano to be more profitable for

buckwheat than for any other crop ; the same is true this year. I have arrived at the conclusion that on quite poor and worn-out land, the application of 50 lbs. of Peruvian guano, costing \$1 62, to the acre, will produce good crops for a series of years. A larger quantity than 50 or 75 lbs. to the acre, will prove injurious—making too much straw and consequently less grain.”

Col. David Moseley, also, “sowed half a ton at the rate of 100 to 150 lbs. per acre with buckwheat. The drought affected some fields so that it would not more than pay for harvesting. It was so with mine where no guano was used, side by side, but where it was used, the drought had very little if any effect. It was all cultivated alike. In raking to set it up, the part where the guano was, produced nine bunches to one on the same distance where there was no guano used, and the straw was increased enough to pay for the guano—to say nothing of the grain, which was very heavy and nice.”

These practical results are sufficient to show the value of Peruvian guano on buckwheat, and indicate that a less quantity per acre should be applied to this crop, to obtain the best results. Where, however, the object is to obtain a rank growth of stalk, to turn in green as a manure, a larger quantity should be used than if the object were to get the largest yield of seed, and 150 or 200 pounds would not be too much for such a purpose.

GUANO ON BROOMCORN.

As might be expected from the general similarity of the two crops, the effect of guano on broom-corn is very much like that on Indian corn.

Alfred Montague, of Sunderland, Mass., wishing to try the comparative effect of guano and barn-yard manure on broom-corn, says : “I measured one and a half acres of good meadow land that had been well manured and well cultivated for a long time. Upon one half of it, I spread and plowed in, eight loads of good yard-manure, for which I paid eight dollars. On the other half, being in the centre of the piece, I spread guano, at the same cost as the yard-manure, (i. e. at the first cost ; the

expense of applying the guano was but little, compared with that of applying the yard manure.) I harrowed in the guano. Then I planted to broom-corn, using a little super-phosphate in the hill upon the whole. The piece was managed alike, during the whole season after the different manures were applied. Many persons who have passed, have asked why the middle of this piece looked so much the best. I referred them to the guano. The crop is not yet harvested, but good judges have said there would be 200 pounds more of broom-brush and a greater excess of seed upon the guanoed half." Such is the testimony all along the Connecticut river valley, where guano has been properly applied to this crop.

Mr. Thaddeus Smith, of Hadley, says: "I have used guano on a piece of land in broom-corn, *for six years in succession, and it holds good yet. I should prefer 400 lbs. of guano to 12 loads of compost manure, for six years to come for the same crop and on the same land.*"

GUANO ON ROOT CROPS.

As already stated, on a previous page, the various phosphates, especially phosphate of lime, may be regarded as the special manure for roots. They require the phosphates in large quantities, while soils generally contain them in small quantities. Hence the very striking effect of an application of a properly made super-phosphate of lime to the root crop, turnips, carrots, beets, parsnips, &c. Now according to a writer in the Rural Cyclopaedia, already quoted, guano is, weight for weight, *fifty per cent. richer in phosphate of lime than even crushed bones*, and the analysis of Prof. Way, the distinguished chemist of the Royal Agricultural Society, discovered no less than 34.45 per cent. of earthy phosphates in one specimen, while the average of analyses of 32 different specimens of Peruvian guano, was 24.12. It is this that makes guano especially adapted to the culture of roots, as its large amount of ammonia makes it also especially adapted to the grains. The produce of grains depends materially on ammonia from whence the nitrogen which they require is obtained. The growth of roots depends

on the amount of phosphates within their reach, either existing in the soil or artificially applied. For grain or root crops, therefore, guano, as might be anticipated from its chemical composition, has been found a powerful fertilizer. More than 30 tons of Belgian carrots have been grown by the use of guano on one acre, which had received nothing but mineral manures for years previous.

What says Dr. Ure, on this point, so important to the grower of root crops? "The Peruvian guano contains from 10 to 25 per cent. of phosphate of lime, the same substance as bone-dust, but elaborated by the birds into a pulpy consistence, which, while it continues insoluble in water, has been rendered thereby more readily absorbable and digestible (so to speak) by the roots of plants. I have therefore no doubt, that by the judicious application of these genuine guanos, mixed with twice or thrice their weight of a marly or calcareous soil, to convert their phosphate of ammonia into phosphate of lime and carbonate of ammonia, as also to dilute all their ammoniacal compounds—such crops will be produced, even on inferior lands, as the farmer can scarcely raise upon more improved soils by ordinary manure."

Without going further into details with regard to the effect of Peruvian guano on these most important crops, we may observe that the experience of our best root growers, and of our largest market gardeners fully corroborates the statements made above, and that the latter feel compelled to use it in considerable quantities, as the most efficient means of getting their vegetables as early as possible into the market, very early crops paying far better on the whole, than later ones.

The great secret of raising root crops successfully, is to keep the land free from weeds, and this is not possible with the use of stable manure. Millions of small seeds not only of the true grasses, but also of many low swale grasses and weeds are carried into the barn in the hay, and find their way into the manure in spite of the greatest care on the part of the farmer, often, indeed, swept into the manure in the form of litter, and cause immense labor in the culture of hoed crops.

We have known many a crop of carrots and other valuable roots, so choked up with weeds, introduced in this way, as liter-

ally not to be worth the hoeing. The use of concentrated manures with these crops, is therefore, almost a matter of necessity, if we are to grow them to a profit, and of all concentrated manures for this purpose, guano is both the cheapest and the best. We cannot be too emphatic on this point, and we say again, without fear of contradiction from any source, use guano on root crops, and if the land needs it, put your barn-yard manure on the land at the time of laying down to grass. You cannot afford to pay the extra labor, which the culture of hoed crops, especially root crops, in land infested with weed seed, will require.

GUANO ON ONIONS.

What has been said above in regard to root crops in general, applies with special force to the onion crop, where its effects are marked and in the highest degree satisfactory. The onion requires a light, mellow and rich soil, but a heavy dressing of stable manures, would not only be detrimental to the crop, but very expensive, both in the original outlay and the increased cost of weeding. No crop requires more cleanly and careful cultivation than the onion, and no one pays better for it.

GUANO ON CABBAGES.

In the report of David Choate, of Essex, above alluded to, he says "guano seems to have done its great work upon the cabbage crop. A large table-spoonful was put in each hill, mixed with a peck of soil. This was upon reclaimed meadow, once submerged, but now producing 4000 noble cabbage heads to an acre. He (Mr. B. the owner) thinks there could have been no cabbages on that land without the guano."

Such is the testimony of all who have properly applied Peruvian guano to this crop, and they concur in saying that the plant heads much fuller and heavier and much more surely with guano than without. After the land is properly prepared mark it off in squares, at suitable distances, depending of course somewhat upon the variety it is proposed to set. Throw out a spade-full of soil where the plant is to stand, and put into each hole a

spoonful of guano, at the rate of about 400 lbs. per acre, and mix and cover it with the soil, set the plants and water them if in a dry time. After the first hoeing a small handful of ashes to each plant may be used to good advantage.

Cabbages, turnips, beets and in fact all plants of the brassica family, will bear a larger and stronger application of ammoniacal manures than most other cultivated plants of the farm. There is scarcely any fear of over manuring them as there is with oats and some of the grains where too strong an application might encourage a too luxuriant growth of straw.

GUANO ON TOBACCO.

We have referred in the preceding pages to the use of guano in the Duchy of Cleves in Prussia. It is found there, that the cultivation of tobacco, in particular, has been very much increased by the use of guano, which gives the plant a vigor of growth that enables it to choke the weeds. It has also been remarked there that the ravages of the slug have been less frequent since the guano came into use. The same has been found to be the case in Maryland and Virginia, where the tobacco worm actually turns sick of guano, and refuses to partake of his accustomed food. More than this, they say there that the tobacco grown with guano has not that rank flavor which it always derives from the use of strong stable manures, in the quantities which the plant requires.

As this plant is a gross feeder the use of 400 or 500 lbs. would be advantageous, unless a considerable quantity of stable manure is also to be applied in connection with it. It may be sown broad-cast and plowed in shallow or harrowed in, or it may be applied at the rate of a spoonful in holes dug to receive the young plants and mixed or covered up with soil two or three inches deep.

But we would never advise so large an application of guano to this crop, but would by all means say use from two to three hundred pounds, and several cords of stable manure in connection with it. Tobacco cultivated with nothing but guano, smokes with a black ash which is detestable to connoisseurs. Not-

withstanding this, from 200 to 400 lbs. per acre can be used with perfect safety and to great advantage to the grower.

Mr. Thaddeus Smith, of Hadley, Mass., who has averaged from twelve to seventeen acres of tobacco, raised with guano, for the last ten years, puts on eighteen cartloads of yard manure to the acre, plowed in as early as the ground is dry in spring. Then in cross-plowing in June, puts on 300 lbs. or 350, of Peruvian guano, 200 lbs. of which are plowed in, and the remaining 100 or 150 lbs. are put in the hill. "For the last three years," he says: "I have left some three acres of an average quality of land where I used no guano, and by good judges it has usually been estimated that *there was not so much tobacco by 300 or 400 lbs. per acre, where no guano was used. The difference was very marked all through the season. Where the guano was used the crop started earlier and kept so all the season. I should prefer 18 loads of barn-yard manure, and 350 lbs. of guano, to 30 loads of barn-yard manure.*

I think 350 or 400 lbs. of guano per acre, should be used to give the crop a start and that that amount will not injure the tobacco, but I am satisfied it will not do to raise tobacco with guano alone."

The same strong testimony to its value, and the necessity of its use, is given by Mr. E. P. Hubbard, of Hadley, Hon. Paoli Lathrop, of South Hadley, and by Mr. Thomas J. Field, of Northfield, and many others, all large growers of this crop in the Connecticut valley.

GUANO ON HOPS.

Guano composted with salt, at the rate of 300 lbs. per acre of the former to 100 lbs. of the latter, with some saltpetre and plaster added if convenient, and sown and harrowed, or plowed in shallow, will be found to be highly beneficial, and to prevent the exhaustion of the soil so generally complained of by hop growers. This plant is also a gross feeder, and requires good land and plenty of manure.

GUANO ON SQUASHES, MELONS, and other vines produces a

striking effect and some of the largest yields have been obtained by its use, especially in connection with farm yard manures.

GUANO FOR GARDEN PLANTS.

One of the largest and most successful grape growers in New England, the Hon. E. W. Bull, of Concord, recently said to the writer of these pages: "Guano is invaluable. It stimulates and promotes a thrifty and vigorous growth of roots. No manure will form roots so healthy and luxuriant as guano, and the horticulturist could not do without it."

Charles McIntosh, author of one of the best "Books of the Garden" ever published, and till recently curator of the royal gardens of the King of the Belgians, says: "This manure before being used should be kept as dry and as little exposed to the air as possible. It is an excellent stimulating manure, beneficial to almost all garden crops, and is found of much service when mixed with composts for pot plants. When applied to growing crops in a liquid state, its effects are speedy and obvious. Indeed we seldom water any plant which we wish to stimulate rapidly, without mixing guano with the water. It is better to apply a little at a time, and repeat the application. In its liquid state we have found it very beneficial to all the *brassica* tribe, to asparagus, rhubarb and seakale."

The reader could ask for no higher authority, and it could not be found if he did.

For celery, asparagus, the pie plant, cauliflowers and other plants whose perfection consists much in a tender and succulent growth, guano is almost indispensable, and it is extensively used in the garden and field culture of these, and similar plants, by the most successful market gardeners.

To strawberries, also, guano has been applied with the most marked success by way of watering with a solution of guano, for which one pound is sufficient for ten gallons of water.

For trees of various kinds, both of the garden and the orchard, it has been found a very useful manure. The late Mr. Teschmacher, says: "The experiments with guano on trees which have come under my observation, including exotics, number

about one hundred and fifty. The action has invariably been to produce large foliage of a deep healthy green." It is customary to work it into the soil at some distance from the trunk of the tree, and where it will find its way down to the fibrous roots.

On grapes, it multiplies and quickens the formation of roots and promotes a rapid growth of wood and it has a tendency to hasten the maturity of the fruit and secure it from the frosts.

On roses and other flowering plants, guano deepens the color and gives far greater brilliancy to the blossom and a thrifty appearance to the whole plant which no other application has been found to produce. Let any one try the experiment judiciously, mixing a little charcoal with it and placing it around, but not in direct contact with the roots, and experiment will prove the truth of the suggestion.

On beans, pease, and other similar garden and field crops it is one of the most economical manures.

Guano, in fact, furnishes the food of plants in a state easily soluble, and ready to be taken up, and is, therefore, better adapted to the wants of vegetation than any other substance.

But many, otherwise intelligent farmers are sometimes heard to say, without much consideration, that "they cannot afford to buy guano at the present high prices." They forget, or overlook the fact, that at three cents, or three and a half cents a pound, the cost of manuring an acre *well*, with guano, is less than ten dollars, a cost at which they could scarcely afford to haul out farm yard manure enough to produce the same effect on the crops as this same ten dollars worth of guano, the transportation and application of which is the merest trifle added to its first cost. It would be equally, if not even more proper to say that they could not afford to manure at all, on account of the great expense of labor of men and teams in forking over, heading, teaming, spreading and applying, and then the additional cost of cultivating a crop manured with stable manure and weed seeds.

Such remarks are, therefore, made without due consideration, since any farmer, whatever may be his circumstances, can afford to make an investment which, with proper care, is sure to pay a

good interest on the outlay. Good economists tell us to invest where we can get quick returns, and not where we must wait for the interest for an indefinite length of time, with the prospect, at the end of it, of losing both interest and principal.

It is an undeniable fact that the use of guano is more and more appreciated by the farmers of Great Britain and other countries, where it has been found that *they cannot afford to do without it*. When the culture of clover and turnips was first introduced into England it was objected to by some, with the remark that the landlord might grow these crops, if he liked, but the tenant must grow something that would enable him to pay his rent. What was the result? He soon found that he could not afford to pay his rent without them; and the same result has followed the introduction of guano.

And so it has been in this country. The consumption of guano has rapidly increased since its introduction, and its economy has become more and more apparent. The importation of it into the port of Baltimore, alone, in the very last year of our Lord, 1859, exceeded that of 1858, by upwards of 42,000 tons!

What says Col. Moseley, of Westfield, one of the best practical farmers in the western part of Mass., on this point? "My experience from the experiments made," (and which, by the way, have extended over several years and to the use of many tons) *proves that one ton of the genuine Peruvian guano will make more corn than one hundred loads of good manure*, worth, with us, one dollar per load, and *300 pounds has always made more corn for me than twenty loads of my best manure*." Here is a better result, at less than ten dollars an acre, and that uniformly, than twenty dollars worth of barn yard manure, to say nothing of the great saving of time, labor and teams, which, when it is considered that it comes at the very busiest season of the year, amounts to a very nice little sum.

Again, some object that the sale of the article is monopolized by the Peruvian government, which, they say, keeps up the price. This objection, when properly considered, will be found to have no weight. It is true the Peruvian government has the jurisdiction over the islands, and is justly, and according to the

law of nations, the proprietor of all the guano on them. That government has established agencies, in all the prominent ports where guano is entered. It fixes the prices of the article and those prices are much lower in this country than they are in England and other countries. But this very monopoly, so far from being unnecessarily arbitrary and burdensome, actually protects the farmer more surely than any other arrangement could possibly do.

Nor are the prices fixed upon by the government, high, considering the intrinsic value of the article. Peruvian guano is cheaper by far, at the present prices, than any other concentrated manure in the market, and as long as its present high character is maintained, it will remain so. Neither the Peruvian government nor the authorized agents could have any motive, while the monopoly exists, for selling an inferior article, but on the contrary, both the government and every agent has a direct interest in keeping up its high character and its perfect purity. Does any one suppose that this high character would be so certainly maintained if the trade were in the hands of speculators? Many of the best farmers of Great Britain have gone so far as to declare that they would not use the article if its management were in the hands of private speculators. *The monopoly of the Peruvian government, therefore, is a sure guaranty of the purity of the article if it is procured directly from the authorized and responsible agents.*

The farmer will sometimes buy a cheap kind of guano instead of the best Peruvian, simply because the price is a little less. There can be no greater mistake. The properties of the best guano are well known, and we can predict with certainty what results will follow the proper application of a certain quantity per acre. With most other guanos there is no certainty as to the results, and the difference in price is seldom proportionate to the difference in quality. The risk of buying them is consequently much greater, and the farmer cannot ordinarily afford to sacrifice both the price of the manure and the time and crops which he may lose by his mistake. The best warranted Peruvian guano should, therefore, have the preference over all others.

Having considered the practical value of guano, it is time to come to the

MODE OF APPLICATION.

It must be evident from what has already been said, that the mode of applying guano will materially affect the result, and hence the importance of the farmer's acquainting himself with the strength and character of the article he proposes to use, and the best method of using it. Much may be gathered from the statements of practical farmers in the earlier pages of this work and from the remarks of scientific men who are familiar with it, but it will be useful to dwell at some greater length upon this part of the subject on which so much of the farmer's success depends.

In the first place it may be proper to say that guano may be stored for a considerable length of time, without being subject to injury, if kept dry and not opened and exposed to the air. If, therefore, it is found convenient to keep it some time, these conditions should always be strictly observed.

If it is to be applied on the surface and harrowed in, as where it is used for a wheat or any other grain crop, *no preparation whatever is needed except to sift out and pulverize the lumps, when it should be applied immediately and harrowed in without delay. For such use we say, most decidedly, never mix anything with it.* If mixed at once with the soil the ammoniacal and volatile parts will be very soon surrounded and absorbed by the particles of the soil. An enormous waste and loss often follow a mixture with any compost containing caustic alkalies, such as ashes, lime or other similar substances. If applied alone the soil will best adapt it for the use of plants.

But if it is to be used as a top dressing on grass or grains, especially with a probability that dry weather will follow, a somewhat different course is generally preferred. When it is first taken out of the bags, let it be sifted as above to separate the coarser lumps from the finer portions. Have a quantity of loam at hand, say not less than five times the bulk of the guano, to be mixed with it. Let a part of this loam be spread on the barn floor or other convenient place and covered with a thin and

regular layer of guano, and another layer of loam and so on, for the purpose of getting as perfect and even a distribution and mixture as possible. These alternate layers, when all is added to the heap, should be shoveled over thoroughly. The addition of loam or some similar absorbent is thought to be important, though rather as a means of diluting it and of enabling the sower to spread it evenly. We are inclined to think it can be sown as uniformly by hand without any mixture as with, and that this labor of composting even for a top dressing, if it is to be applied at the proper time, may be saved. A larger quantity of dry loam or muck may be used if thought desirable.

The lumps may be pounded up and mixed like the rest, or they may be covered up in a considerable quantity of muck or loam and left for several days in a dry place, when they will become softened and may be mixed with greater ease.

If the farmer has plenty of leisure and adopts this method of composting rather than of applying without any mixture, let the compost, after it has been carefully formed, remain under cover for some days, in a dry place, not exposed to a draft of air, before using it. The whole mass will thus be penetrated with the strength of the guano and a more even distribution will be practicable. The mixture will be improved if it can lie two or three weeks in this way, or even longer if the air has little access to it.

Select, if possible, a damp showery day to sow it in, especially if the application is to be made broadcast as a top-dressing for grass or grain lands.

For this purpose the time of the application may be in the month of November or on the late snows of March or April, but not later. If it were proposed to apply 300 lbs., which is found by experience to be sufficient on ordinary crops to produce the best results, it would be a very good plan to apply 150 lbs. in November, spread as evenly as possible, and to reserve the remainder till March or early in April, especially if the land is pretty level so that the top-dressing will not be liable to be washed off. A top dressing is sometimes successfully made as late as May, but the liability to drought is so great that it is not to be recommended if it can be avoided. "Better late than never."

may still hold good, but if on a late spring application, no very striking results should follow, do not condemn the guano, but determine the next spring to take time by the forelock.

The rule should be to top-dress grass lands in November, March or April, and to select for it a damp, drizzly day. Of the two we should rather give the preference to the former period, as by it a vigorous growth of root is promoted and the plant feels it early in the spring, and if the weather were all right, we should not think it so important to compost at all.

If applied to arable land, it should be immediately covered with the harrow or otherwise, so as to be mixed with the soil, and if the piece is designed for grain, the application of guano would be best a few days, say a week or ten days before the grain is sown, where it is practicable to do it. It then becomes so thoroughly incorporated with the soil that there is no risk or danger of injury to the tender roots of the plants. If it is designed to sow it on winter wheat or rye, let only half the amount intended to be used be applied in the fall, and reserve the remainder to apply as a top-dressing in March. If too large a quantity is applied to the crop in the fall it might stimulate a too thrifty and tender growth, and render it more liable to winter kill. But the use of a part of it in autumn is important to promote a strong and vigorous growth of root when it will be far less liable to be heaved by the frost. Many a crop might have been saved from being frost thrown by the use of guano.

We say, therefore, prepare the land, sow on 150 lbs. of Peruvian guano, and harrow it in a week before you intend to sow the wheat if it is practicable, that is if the weather is damp, and the land in suitable condition. Guano ought not to be applied, of course, in the midst of a drought when the surface soil might have somewhat the appearance of an ash heap. In such a case, it would be far better to wait till after the crop was fairly up and spread it broad-cast in some rainy day as a top-dressing, or even to sow it on, and harrow it in, with the wheat or rye.

If practicable and convenient, however, we prefer the former method of applying it, some days beforehand. The absorbing power of the soil will hold the volatile parts of the manure

ready prepared for the roots of the plants without the addition of loam or any other mixture, and thus a good deal of unnecessary trouble will be saved. The wheat or rye may then be sown and harrowed in, or which is far better, drilled in, with no liability to injury from too close contact with the guano. If, then, it has another dressing of 150 lbs. as a top-dressing on the late snows of March or April, it will produce a better crop than if the full amount were applied at once.

For oats, which are sown in the spring, we have already advised a somewhat less quantity per acre, say, 150 lbs. or 200 lbs., and we would not take the trouble to compost, especially if the guano can be spread and harrowed in a few days before sowing the seed. The guano ought, however, to be sifted as before, and the coarser lumps broken up as finely as possible, otherwise its distribution would not be even and uniform.

And the same may be said of buckwheat, on which if it were designed for a crop, we should not advise the use of more than 100 lbs., or 150 lbs. per acre. But if we wished to obtain a rich and luxuriant growth of buckwheat or other similar crop to turn under as a green manuring, a considerable larger quantity might be used to great advantage, since the design is to get the largest possible mass of vegetation, and no application will give it so quickly or so cheaply as Peruvian guano. For light, sandy and barren lands, this mode of treatment can hardly be too strongly recommended. Once get them into good heart in this way, and they may be easily kept up and made productive.

Guano may be mixed with perfect safety with charcoal or with muck, or dry meadow mud, with salt, sand or stiff fine loam ; but ordinarily, except for top-dressing as indicated above, it is better to use it alone and thereby save considerable labor which is wholly unnecessary and useless. We do not believe it can be spread any more evenly by hand, in a compost than it can by itself alone. And even for a top-dressing it is scarcely necessary to compost it with anything if it is applied in November or in March on the late snows, or in a rainy day. Still there is no particular objection to a mixture with any of the substances indicated above if any one chooses to take that course. But it should never, on any account, be mixed with quick lime

or any other strong alkaline substance, nor should it be allowed to come in direct contact with the seed.

We should not recommend its mixture with wood ashes either leached or unleached, because they always contain more or less alkaline substances, which might set free a part of the ammonia of the guano. Some would not mix it with plaster, because of its liability to form an insoluble compound the action of which would be slow and proportionally less valuable. But if it is to be immediately applied in the hill where it will be at once surrounded and mixed with the soil, the objection to the use of ashes would be removed, since the loss which would otherwise follow, would be checked by the absorbing power of the soil. And many use plaster in a mixture with guano with success, but if the land needs plaster and is apparently benefited by it, we think it just as well to apply it by itself directly to the crops, and the guano by itself. Fine charcoal or the scrapings of coalpits, may always be used to advantage mixed with guano, and it will prove a valuable absorbent and retainer of the ammoniacal or volatile part of the guano.

In sowing down to grass in September, we would put in the guano with the harrow the same as for winter wheat, say ten or twelve days before the grass seed was to be sown, or else wait till the seed had come up and then take a rainy day and sow it on as a top-dressing. If we composted the guano with loam for this purpose we should want it to remain in the heap a few days till the whole mass was fully saturated with the guano, using only a part of the full quantity we intended to apply and reserving the balance to be applied on the late spring snows. Guano, though it will destroy the germinative power of seeds placed in too close proximity to it, will not injure growing crops when sown broadcast on them, unless applied in enormous quantities, far greater than any one would think of applying as a manure.

So much for top-dressing either grains or grasses. If now it is proposed to use it in the hill or the drill, on the corn or other crops, it has generally been thought best to mix it thoroughly, as before indicated, with loam, sand or other similar substance to *dilute* it. If this course is to be pursued, and the soil on which it is to be applied were light and sandy, we should mix the gua-

no, if at all, with stiff loam; if the soil were heavy we would mix it with sand.

It is better and safer as a general rule, to mix the guano with the surface soil by harrowing it in than to confine it in the hill or the drill.

The impression, which some have, that the effects of guano are not so lasting as other manures in the soil, has arisen chiefly from those cases in which it was put in the hill, and not incorporated with the great body of the soil. A very small quantity applied in holes, say three feet or more apart, has but little chance to become thoroughly mixed with the great mass of the soil. But where it is spread, either the whole or a part of it, and plowed or harrowed in, it becomes diffused and affects and improves the whole soil.

But it is important sometimes, to obtain a quick and thrifty growth of the corn or other crops, and this may be done by putting guano in the hill and so covering it up, or thoroughly mixing it with the soil, that it will not come in contact with the seed. Billings' corn planter will drop it and cover it up an inch or more in depth and drop the corn upon that. But if this is not to be had it may be dropped by hand at the rate of a tablespoonful of guano, or if composted with five or six times its bulk of fine loam, a small handful, which should be covered up with the hoe not less than an inch or an inch and a half deep before dropping the corn upon it.

Many disappointments have occurred in consequence of not covering it deep enough to protect the seed. There is no fear that the roots will not find it soon enough, even if it is more than two inches deep, and the slight covering which it too often gets with the foot is not sufficient. The more it can be mixed and incorporated with the soil the better, and if half of the amount which it is designed to use is spread and harrowed in, and a smaller quantity, say not over 150 lbs. for corn, placed in the hill, it would doubtless be safer and more satisfactory.

We would strongly advise the use of guano in connection with barn yard manures, on lands which are within a reasonable distance from the barn. The use of guano as a valuable auxiliary to other manures has not been sufficiently considered.

Attention to the difference of effect between coarse and concentrated manures as stated on the 14th and 15th pages will show the importance of the use of a variety of manures to produce the best results. Where it is practicable, therefore, we would use guano in connection with stable manures, and if it were generally so used, we should very rarely hear of the occurrence of a failure charged either to the crop or the soil.

Suppose, for instance, the farmer were intending to apply forty common cart loads of stable manure per acre for a crop of corn or potatoes, and that that were sufficient to manure the acre well. Let him spread twenty loads and plow it in and apply 150 lbs. of Peruvian guano in the hill. The aggregate cost of manure and cultivation would be less, and the aggregate value of the crop in quantity and quality greater than if the acre were manured with the forty cart loads of manure. For in a season like 1855, or especially like that of 1859, the crop would be from one to two weeks earlier in ripening, and escape the autumn frosts much more surely, while the number of bushels per acre would be greater. The stable manure would supply a sufficient amount of organic substances to the soil, and the guano the necessary constituents or the food of the plants. The statements of successful experiments on the preceding pages and all experience as well as scientific investigation, are sufficient to prove this beyond the probability of contradiction. The largest and most successful products of corn in New England, in 1859, were cultivated with guano in whole or in part, and there were comparatively few superior and first rate crops where it was not used to some extent.

Three hundred pounds per acre is usually considered to be a very fair manuring with good Peruvian guano, and if several loads of barn-yard manure are spread and plowed in, 150 or 200 lbs would be sufficient. This quantity of guano put in the hill would stimulate the early growth of the corn, or give it a rapid and thrifty start, while the manure which had been spread and plowed in, ought to become so far decomposed by August or September as to carry up the crops to maturity. It is not very safe to plant corn with all the manure spread broad-cast, and plowed in, unless the soil is very rich. It needs something

to give it a start, and unless it has it, it will linger along sometime without making much head-way. This slowness of growth may cause a lateness of ripening in the fall which will be fatal to the crop. For the benefit of the soil the manure should be spread broad-cast and plowed in; for the success of the crop a part of it ought to be put in the hill, and for this purpose guano is most excellent.

For potatoes a somewhat similar course would be recommended. We would not, with all the light we have as to the deleterious effect of barn-yard manures on this crop, think of putting these manures in the hill and planting potatoes on them. Let the green or stable manures be spread and plowed in, then cross furrow and drop the guano in the hill and mix it or cover it over carefully with the soil, so as not to place the potatoes in immediate contact with the guano. A spoonful of plaster put around the potatoes before or at the first hoeing, will materially help their growth.

For carrots, beets, mangold wurtzel, parsnips, and other tap-rooted plants which require a thoroughly pulverized soil, and on which the use of yard manure is injudicious on account of the liability to encourage the growth of weeds, we should say plow once very deep and then spread on 300 lbs. of guano before cross-plowing and turn it in with the plow a few inches deep. Then we would mix a guano compost, using say 100 or 150 lbs. per acre, after being diluted beyond the possibility of injuring seed in contact with it, and apply it along the drills or by means of a drill-machine. For the smaller root crops, especially, the land should be perfectly clean and free from weeds, else the labor and cost of weeding will eat in largely upon the profits.

For forcing beds, for starting early crops and like purposes, frequently practised by market and other gardeners, guano may be mixed directly with the manure by forming alternate layers as directed in the preparation of an ordinary guano compost, and then forking over thoroughly so as to get as complete a mixture as possible. This addition will give the common stable manures much greater stimulating power, and enable the gardener to get out his plants earlier than it would be possible in

any other way. Guano is sometimes mixed directly in this way by the farmer in forking over his manure heaps in the spring, as for instance where barn-yard composts have been hauled out the autumn previous and tipped up in heaps upon the field where it is intended to use them, and instances of very marked success in this mode of using it are at hand. But though it is valuable mixed in this way for giving the manure much more power and quickness of action, we think it rather preferable to apply it as indicated on a preceding page, the manure by itself and the guano by itself, chiefly because it is a little less labor, and because the guano would naturally be subject to little more exposure and loss of ammonia in forking over with the other manures as many times as it would be necessary.

For beans, pease, millet, &c. when cultivated as a field crop, we think it safer generally to spread broad-cast and harrow in. A very diluted guano compost might be used in the hills or drills with safety, perhaps, but when a sufficient quantity is spread evenly and incorporated with the soil in this way, the rains will diffuse it so well that there need be little fear that the fibrous roots of these crops will not find and feel the stimulating influence of the guano.

For squashes, cabbages, cauliflowers, &c., we think a good application, say 300 lbs. per acre, spread and harrowed in, or plowed in shallow in cross-plowing, and a diluted guano compost used in the hill advisable. These crops will bear a good deal of forcing and it is of the greatest importance to give it to them. For such a compost, a mixture of ashes and loam may be used with the guano, if it is to be covered up immediately after mixing.

For onions we would apply guano at the rate of four or five hundred pounds per acre; spread on after a deep thorough plowing and harrow it in. Onions require a rich, deep soil, though they grow and derive much of their nourishment near the surface. It is well known to onion growers that the use of a heavy dressing of stable manures will produce coarse grained onions, which are much less valuable in the market than those grown with a concentrated manure, or with a suitable mixture of a variety of manures. Any one conversant with the market,

knows the difference between what is called "coarse" and "fine," as applied to this root.

For many garden plants, and especially for pot plants, a solution of guano has been found exceedingly useful. It causes a strong and healthy growth and multiplies the roots as well as promotes a rapid growth of stalk. For this purpose it is well to have a cask of water at hand and apply the guano at the rate of about a pound to ten gallons of the water. It should be stirred up occasionally, and applied frequently in small quantities by the watering pot. The cask should be kept covered up, and not allowed to stand exposed in a hot sun. A frequent application in this way will be found to give great brilliancy to the color of roses and other flowering plants.

The mode of applying guano has so much to do with the result that we venture an apparent repetition in stating a few general rules: 1. Guano, if stored, should be kept dry. 2. Guano is best applied in damp, rainy weather. 3. Guano when applied to cultivated land ought to be immediately mixed with the soil by the plow or the harrow. 4. Mix it with the surface soil rather than confine it in the hill. 5. If it be applied in the hill, first mix it with five times its bulk of ashes, charcoal, salt, or cover it up carefully with soil before dropping the seed. 6. Guano ought not to be applied as a top-dressing later in spring than the first of May. 7. When applied to fall sown grains or grasses, half the quantity should be reserved till March. 8. Apply it only in quantities sufficient for the crops it is desired to produce. 9. Guano should never come in contact with the seed. 10. Buy of responsible and authorized dealers.

The judgment of the farmer and gardener, aided by the above suggestions, and by his own experience, will enable him to make the application to any crop not mentioned above, and in circumstances which have not been anticipated in these pages.

The soils on which guano has the most marked and powerful effect are light and sandy, or what are most frequently called poor and worn out. On such soils there can be no question of the economy of its use, for by it good grain and clover crops can be obtained, and wherever a good clover crop can be made

to grow, the soil can be brought up to a high state of productiveness by judicious management.

But though on these comparatively worthless soils it seems to have the most marked and decided effect, it may be applied with profit and advantage on any soil which can be economically cultivated with any crop, and for the reason which has been given on a preceding page, that it contains the largest amount of available food in readiness for plants, of any known substance used as a manure.

Light sandy soils do not need the mechanical improvement which our common stable manures produce in heavier soils, and hence coarse manures are not so much needed on them as on clays. On the latter, the coarser manures are used to great advantage as a means of correcting their physical texture, but as a direct and ready prepared food of plants guano is equally useful on them as on lighter soils. Hence, while it may always be used alone on the latter class of soils, whose physical texture, if modified at all, needs to be rendered more compact, on the former, or undrained clays or stiff loams we have recommended its use in connection with, and as an auxiliary to stable manures.

Guano cannot injure or "burn up" the soil, as some pretend, if it is applied as indicated above, or indeed in any other way, unless it were used in enormous quantities which no one would think of applying to produce any ordinary crop. We know of one instance where it was applied at the rate of 4800 lbs. per acre to produce a rapid and luxuriant growth of young trees for a specific purpose. In that case alternate rows of carrots were sown and yielded at the rate of more than twenty one tons per acre. No perceptible injury was done to the land, nor is it probable that ten tons to the acre could in any way injure or "burn it up."

The farmer may depend upon it and set it down as a general principle on which it is safe to act, that the wisest economy is perfectly consistent with a liberal outlay for manures, and that he who puts the most into the soil, if he does it with ordinary prudence, will be sure to get the most out of it.

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